Blood Lead Reduction for Lead Recycling

Workers, their families and the plant's neighbors

Capacity Building Workshop on Spent Lead Acid Batteries and Electronic Waste

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by

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Reducing Blood Lead Levels

- **Limit Dose**
  - **Inhalation**
  - **Ingestion**
  - **Skin Absorption**
- **Maximize Excretion**

Reducing Blood Lead Levels

- **Limit Absorption by reducing**
  1. **Dose (entry into body)**
  2. **Amount absorbed after entry into body**

Reducing Blood Lead Levels

- Personal Hygiene
- Housekeeping
- Personal Protective Equipment
- Control Airborne Dust

Maximum Tolerable Lead Dose

World Health Organization (WHO) recommendation:

– "Provisional Tolerable Weekly Intake" (PTWI)

0,025 mg/kg bw

(milligrams per kilogram of body weight)

– For a 100 kg person this is 2,5 milligrams per week

Maximum 24 Hour Lead Dose

An aspirin weighs 100,000 mcg

350 mcg = 1/300

Maximum daily dose:

100 kg person - 350 mcg

50 kg person - 175 mcg

20 kg child - 70 mcg

Maximum Daily Dose – Arsenic and Cadmium

Arsenic

- PTWI* is 0,015 mg / kg bw
- For 100 kg person
  - 1,5 mg / week

or

  - 215 mcg / day

Cadmium

- PTWI* is 0,007 mcg / kg bw
- For 100 kg person
  - 0,7 mg / week

or

  - 70 mcg / day

* Provisional Tolerable Weekly Intake

Excretion of Lead

- If absorption is less than tolerable dose, lead is removed from body storage and excreted.
- If absorption is greater than tolerable dose, lead is placed in storage.
- It takes 2 to 3 times as long (or longer) for the blood lead to come down.

The body excretes lead by every means possible

- Urine
- Feces
- Sweat
- Saliva
- Mucus
- Shed skin cells
- Hair
- Finger and Toe Nails

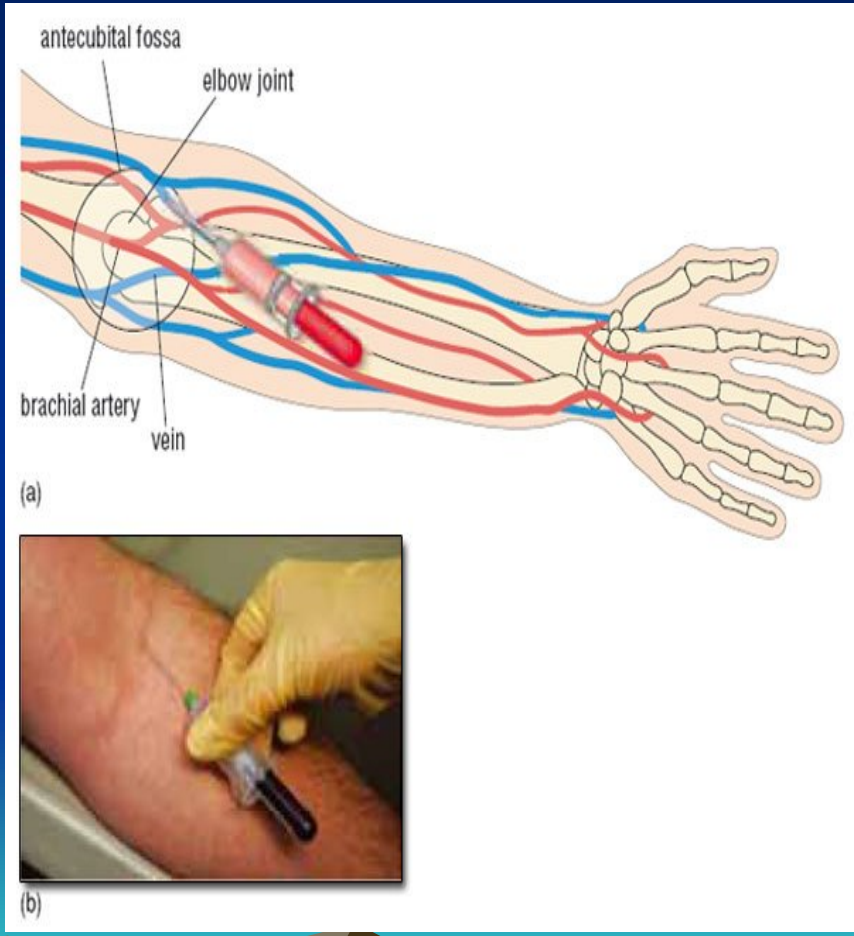
How Lead Enters the Body

- **Inhalation**
- **Ingestion**
- **Skin Absorption**

- **Surface area of Lungs is 100 m^2**
- **Surface area of digestive system is 10 m^2**
- **Surface area of skin is 2 m^2**

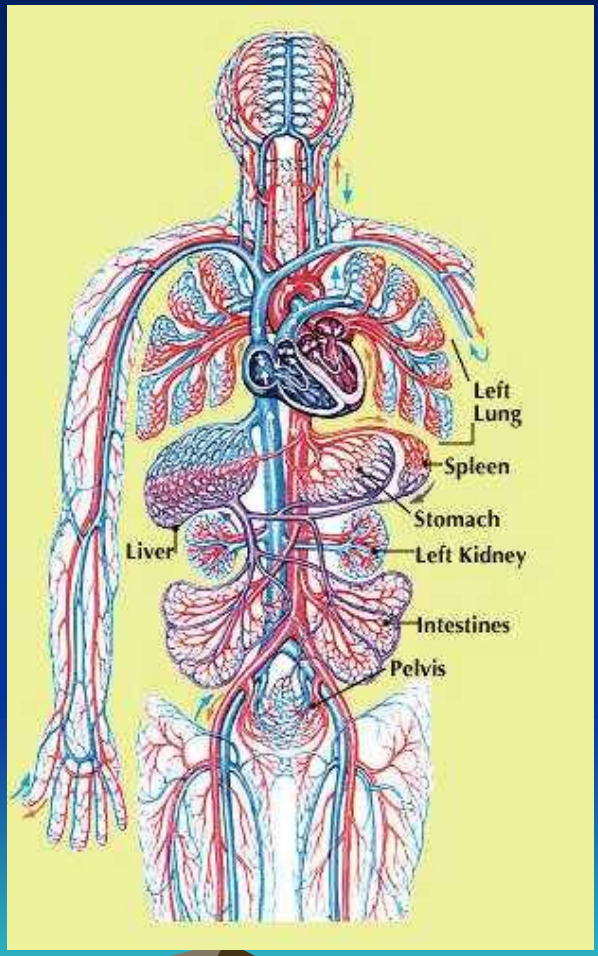
Measuring the Results – Blood Lead and Blood Cadmium

- Frequency depends on level but normally no more than 1 per month
- Sample Room and supplies must be exceptionally clean
- Blind duplicate sample – 1 per 50



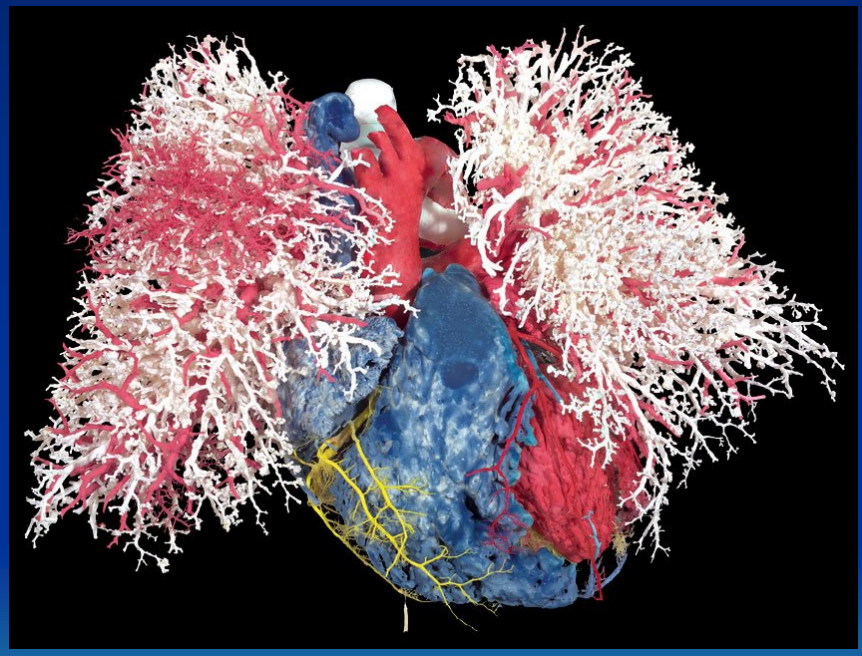
Inhalation, Ingestion & Skin Absorption

All 3 routes contribute to dose and body burden



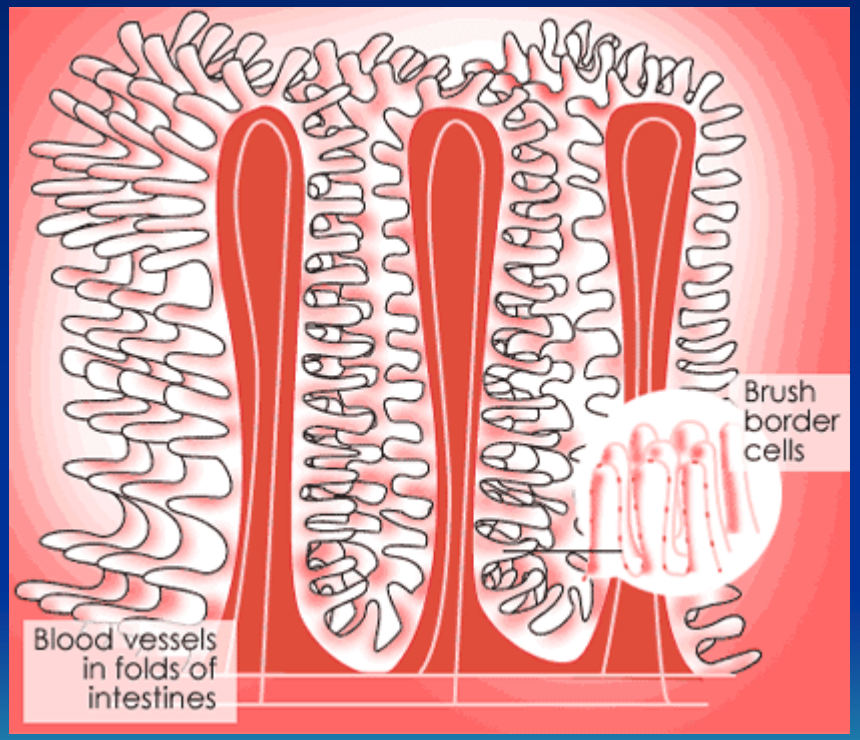
Inhalation, Ingestion & Skin Absorption

- **Inhalation is efficient – the lungs are designed to transfer material from the air into the blood.**



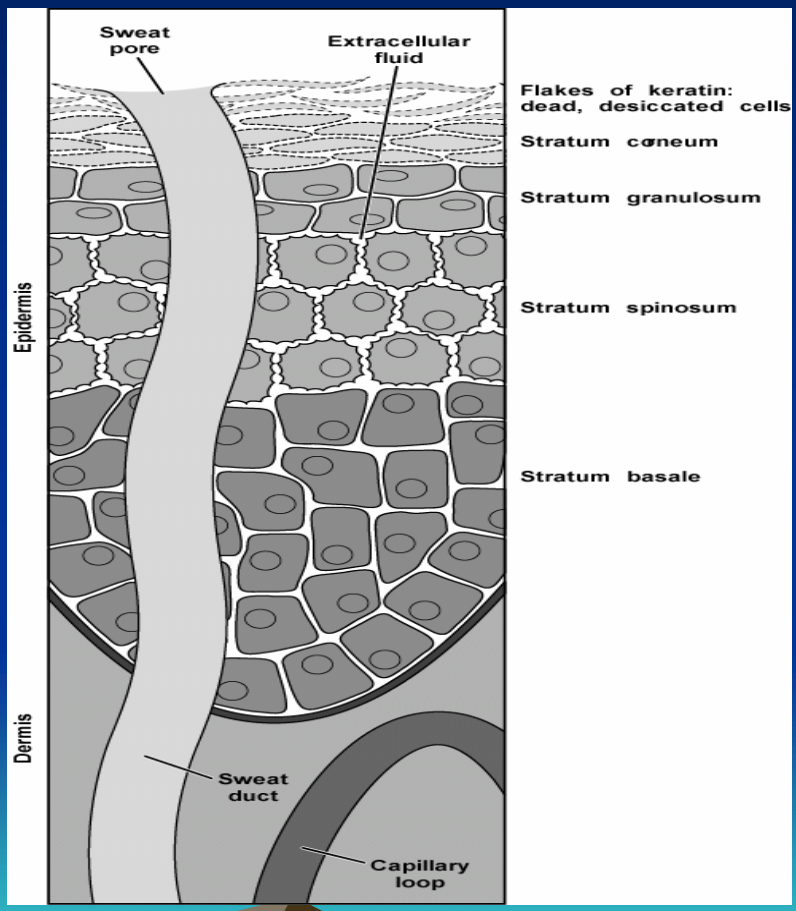
Inhalation, **Ingestion** & Skin Absorption

- Pb is absorbed quickly and efficiently in an empty stomach



Inhalation, Ingestion & **Skin Absorption**

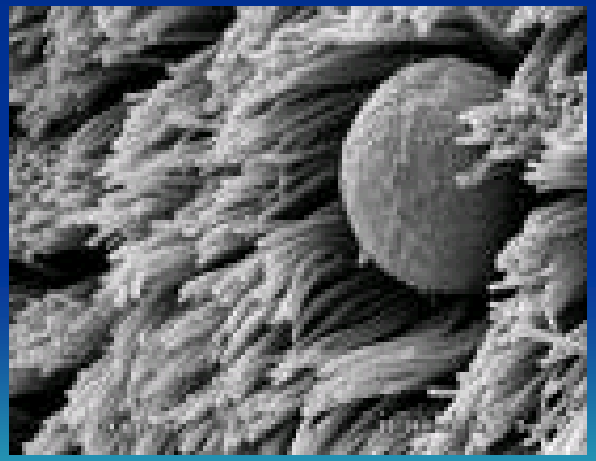
- **Lead and Arsenic on Skin is ingested and inhaled**
- **Water soluble lead enters through sweat ducts and hair follicles.**
- **Sweat is acidic and can dissolve lead.**



Inhalation Efficiency is Size Dependent

- **0.3 - 10 micron particles are efficiently deposited in the lungs.**
- **Absorption time is 36 to 72 hours to dissolve and move into the blood.**

- **> 10 micron particles are removed by nasal hair, mucus and cilia, some is cleared by coughing and sneezing**
- **most is ingested.**



Cilia in throat

Lead and other Metal Fumes

- < 0.3 micron remain suspended in the tidal air and are immediately exhaled
  - (unless trapped by mucus and cilia and ingested)
- Freshly generated lead fume (evaporated lead) 0.3 to 1 micron
  - Fresh lead fumes have a greater impact on blood lead than other lead compounds
  - The lungs maximum retention efficiency is in this size range.

Reducing Inhaled Lead

- Control Airborne Lead
  - Identify and Rank Sources
  - Eliminate / Enclose / Ventilate
  - Ventilation
    - Capture Efficiency
    - Filter Efficiency
  - Control Fugitive Sources

Identify & Rank Sources

Start with:

- Visible dust
- Lead fume

Identify & Rank Sources

For each source

- Identify and rank dust quantity, duration and timing.
- Where does it go?
- Estimate cost to control
- Calculate $/KG emission reduction

Fugitive Emissions

- Spray storage piles with water mist or -
- A light spray of Paper Mache over stock piles reduces wind driven dust

Mix 50 kg of waste paper pulp with 15,000 liters of water.

Fugitive Emissions

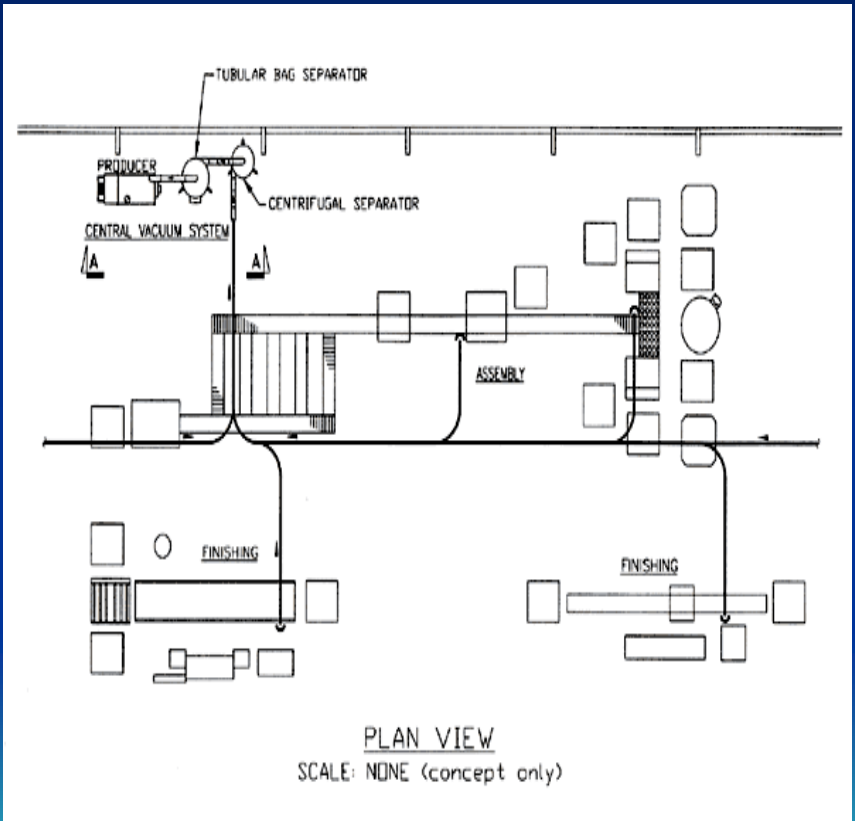
- Green Screens –
  - Plant vegetation for wind breaks to trap dust leaving site

Housekeeping

All Surfaces as clean as practical

- ✓Plant – in and out
- ✓Locker Room
- ✓LUNCH ROOM !

Central Vacuum System

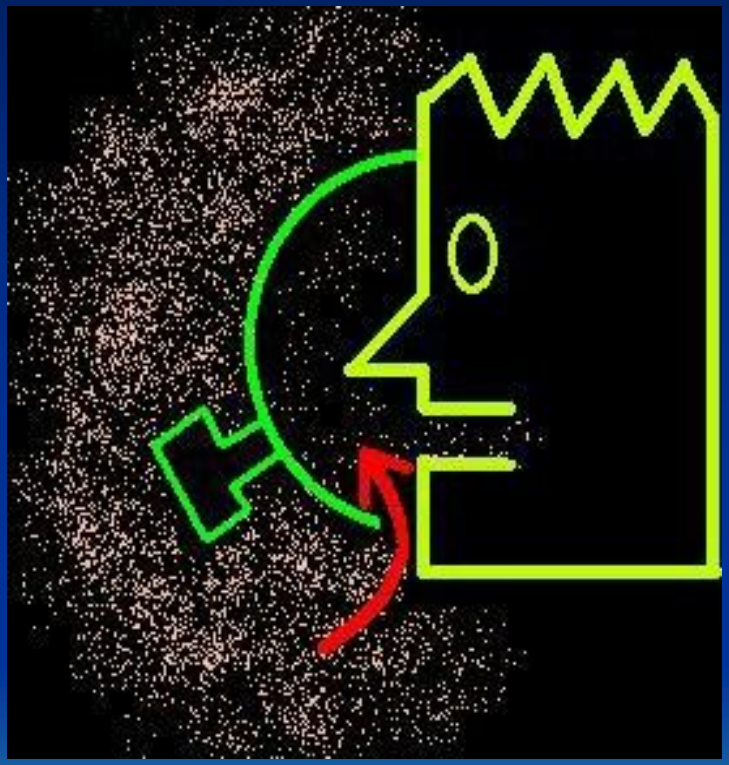


Respiratory Protection

- Respiratory protection is effective in reducing inhalation dose
- P-100 (HEPA) (purple) filters remove all metal dusts and fumes as well as acid mists (they do not remove acid gases).
- Medical evaluation to determine ability to work in a respirator

Respirators

- Respirators are only effective when they are
  - WORN and sealed to the skin
  - NO facial hair, clean shaven every day
  - FIT TESTED – no face seal leakage



Ingestion

Personal Hygiene is key!

- *If air leads are high*
  - *Personal hygiene will reduce blood lead levels*
- *If air leads are low*
  - *Personal hygiene will reduce blood lead levels further*

PROPER GLOVE HANDLING

1

2

3

4

WASH STATION

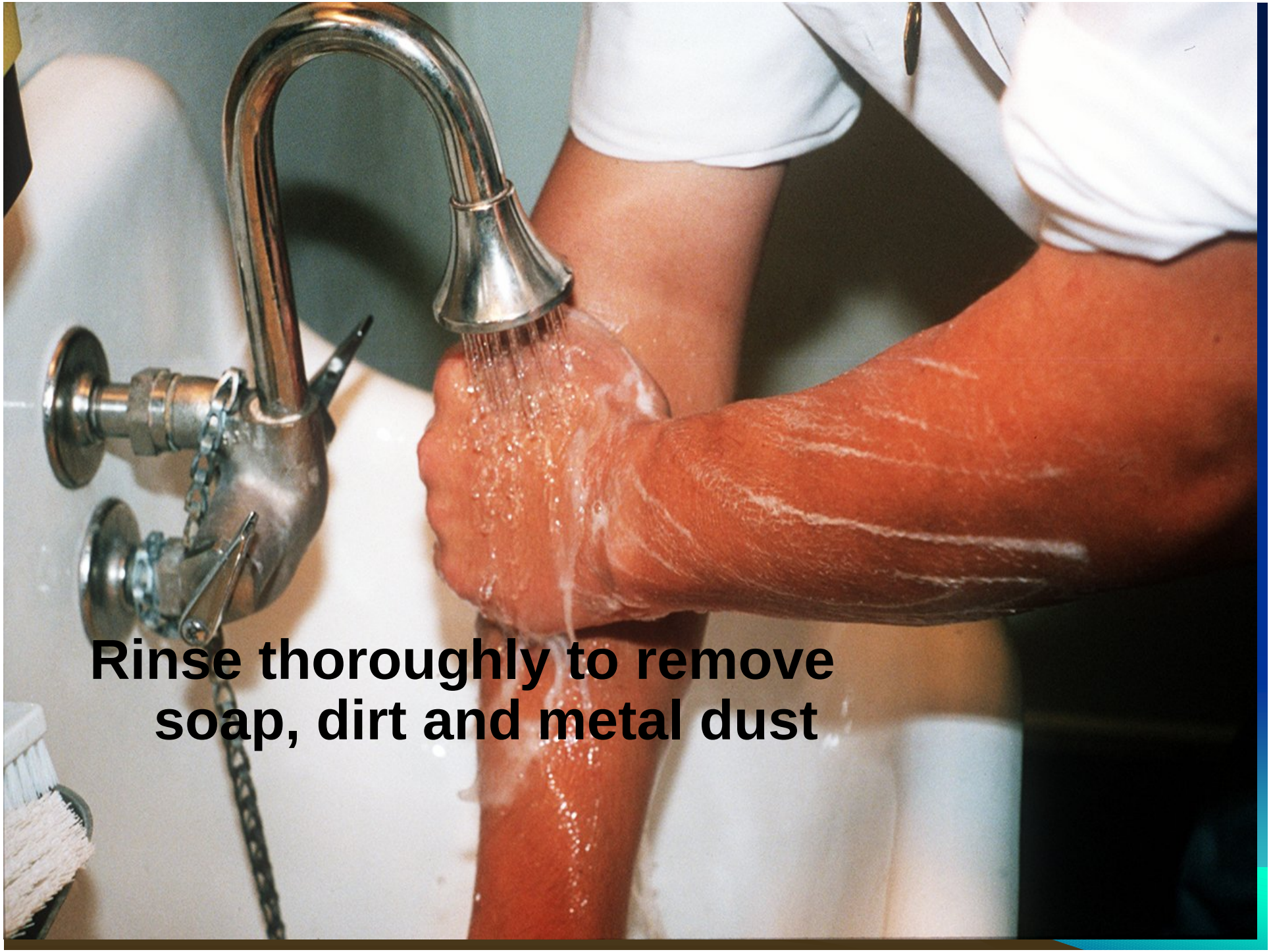
Large sink for elbow room


Use lots of water

Wash hands thoroughly

Wash arms

Then face & neck.


Rinse thoroughly to remove
soap, dirt and metal dust

Use towels to dry hands, arms, face and neck.

Lead Dust is difficult to clean

- **Lead is HEAVY**
- **Lead is sticky and a cement**
- **Lead is difficult to wet**
- **Lead forms soap scum (bathtub ring)**
- **Lead smears**
- **Lead dust is not abrasive**
- **Lead dust holds a large static charge**
- **Lead is small and gets trapped in porous surfaces**

Lead on Skin

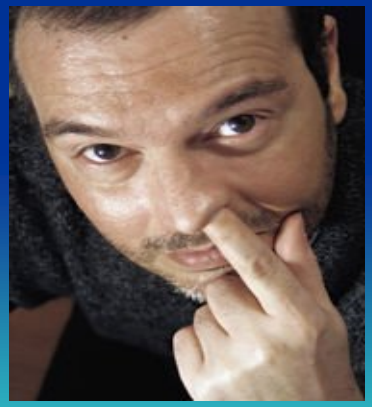
- Lead sticks to the skin
- Soluble lead and metals migrate through the skin
- Sweat and saliva are acidic and dissolve lead
- Lead in sweat can exceed 75 mg/liter (excretion path)
- Lead resides in skin pores, sweat glands, sweat ducts and hair follicles

Personal Hygiene Program

- Use effective Lead Removing Skin Cleaners
- Test Hands regularly for lead
- Teach wash and shower technique
- Shower after every shift

Personal Hygiene Program

- Observe personal hygiene habits and re-train
  - Biting nails
  - Hands **to nose and mouth**



Personal Hygiene Program

- Lunch, locker and break rooms clean
  - Construct with Non-porous materials
  - Frequent cleaning schedule

Wood is porous

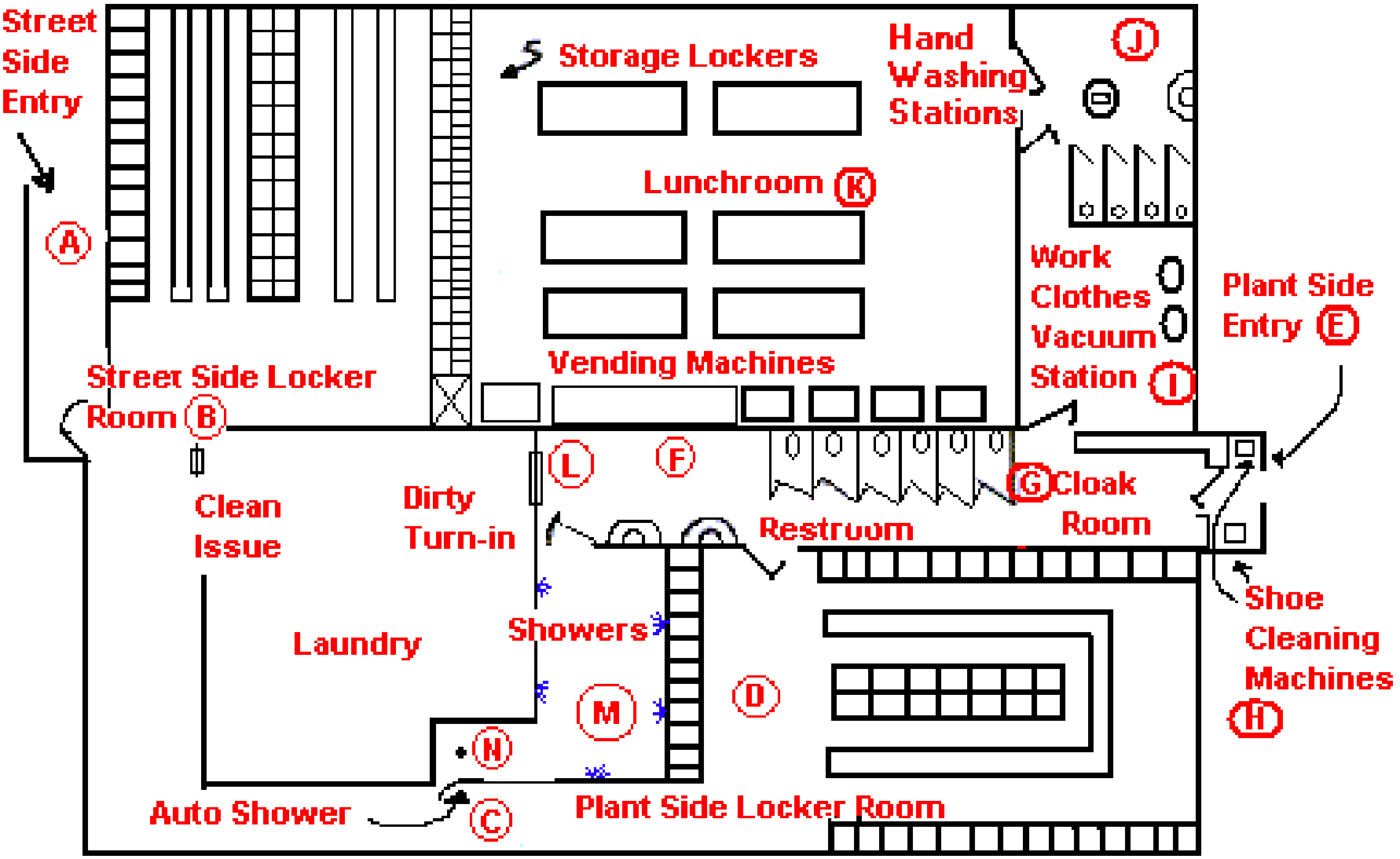
Respirator Laundry

Test Respirator Cleaning

Personal Hygiene Practices

- Smoking, eating and drinking is strictly forbidden in process areas except in lunchroom.
- Clean properly (wash hands, arms, face, mouth; shoes), even for short breaks
- All workers trained to take a proper shower at the end of each shift.
- No consumables (cigarettes, chewing tobacco, gum, candy, etc.) or personal items (i.e., wallets, keys, cell phones, etc.) in the plant.
- Working dress (even socks & underwear) should be changed as often as necessary.
- Workers should wear a dust cap as part of the working dress (to prevent hair from being a hidden source for lead dust).
- Workers should vacuum clean clothes and clean their shoes before leaving the lead area.
- Workers should not wipe away sweat with hands or arms, supply workers with single use (disposable) perspiration towels.

Hygiene Facilities



Leave Lead at Work

- All work clothes
- Work shoes
- Socks, underwear
- Provide “Overbags” for employees to keep personal items while on site – especially for contractors

Leave Lead at Work

- All work clothes
- Work shoes
- Socks
- Underwear?

Shoe Cleaners

Why is Lead Toxic?

- Calcium and Lead are similar
  - Body confuses Pb^{++} with Ca^{++}
  - When lead is present at high levels, then body uses lead in critical functions instead of calcium.

Nutrition is Important

- Diet can make large differences in lead absorption and retention
  - Lead is absorbed 4-10 X higher when the stomach is empty
  - Coming to work fed reduces the absorption of ingested lead
  - Some fiber, such as kelp, psyllium, fruit and vegetable fiber all reduce absorption

Nutrition is Important

- Eat a good meal before coming to work
- High fiber diet reduces absorption and storage of lead
- Take a basic multivitamin
- Calcium with Vitamin D reduces absorption
- All the major nutrient minerals - Zinc, iron, calcium - greatly reduce the absorption and bone uptake of ingested lead

Reducing Blood Lead Levels

- Personal Hygiene
- Housekeeping
- Personal Protective Equipment
- Control Airborne Dust

Gracias

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